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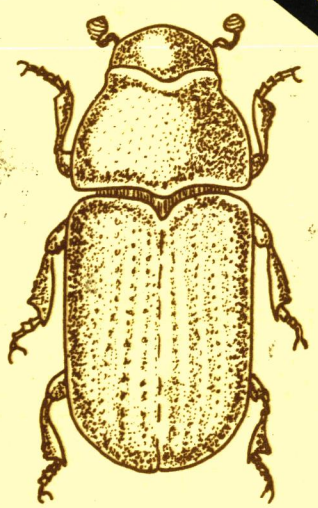
BIOLOGICAL EVALUATION
Western Spruce Budworm

National Forest, National Park, Indian Reservation, State, and Private Lands

Region 3

1977



Southwestern Region

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Western Spruce Budworm

National Forest, National Park,
Indian Reservation, State, and Private Lands
Region 3

1977

Forest Insect and Disease Management
State and Private Forestry
Southwestern Region, Forest Service, USDA
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TECHNICAL INFORMATION

Insect.--Western spruce budworm, Choristoneura occidentalis Freeman

Hosts.--Douglas-fir, Pseudotsuga menziesii (Mirb.) Franco
White fir, Abies concolor (Gord. & Glend.) Lindl.
Subalpine fir, Abies lasiocarpa (Hook.) Nutt.
Blue spruce, Picea pungens Engelm.
Engelmann spruce, Picea engelmannii Parry

Location.--The following entomological units were sampled in 1977 (Fig. 1):

Gila Unit (Fig. 2).--Reserve RD, Gila NF - 10 plots.

Jemez East Unit (Figs. 3 through 7).--Espanola RD and Tesuque RD, Santa Fe NF; Bandelier National Monument - 97 plots.

Kaibab Unit (Fig. 8).--North Kaibab RD, Kaibab NF; North Rim, Grand Canyon National Park - 20 plots.

Manzano Unit (Fig. 9).--Mountainair RD, Cibola NF - 19 plots.

Questa Unit (Fig. 10).--Questa RD, Carson NF - 20 plots.

Sandia Unit (Fig. 11).--Sandia RD, Cibola NF - 20 plots.

Taos Unit (Fig. 12).--Taos RD, Carson NF; Taos Pueblo Indian Reservation - 20 plots.

Type of Damage.--Western spruce budworm larvae damage host trees by feeding on new foliage. Young larvae mine into the swelling buds and flowers in the spring. Mature larvae continue feeding on the expanding shoots and needles. As the larvae feed, they web shoots together. These webbed shoots become reddish brown by July and will eventually fall from the tree. Moderate to heavy defoliation for 3 to 5 years will cause growth loss. If heavy defoliation continues, trees will die from the top downward.

Extent of Damage.--Western spruce budworm defoliation in 1977 was observed during aerial surveys on 197,788 acres (80,044 hectares) of the entomological units sampled. Defoliation was categorized by severity as: light - 171,992 acres (69,604 hectares); moderate - 23,716 acres (9,598 hectares); heavy - 2,080 acres (842 hectares).

METHODS

Region 3 has been divided into entomological units based on geographical location of contiguous host type and past history of budworm infestations. Aerial detection survey data from 1976 and 1977, on the extent and severity of defoliation, were used to determine which units should be included in the biological evaluation.

Within each unit, plots were established. The number of plots per unit is shown under the Technical Information section. The Jemez East Unit was divided into four subunits as part of the unsprayed check area for a suppression and evaluation spray project conducted this year. Each subunit was independently sampled for the project, but the data from all four subunits have been combined for this evaluation to give an intensively sampled unit.

Sampling was done during August 1977. Each plot consisted of 3 trees within a 1-acre (.40 hectare) area. Sampled trees met the following criteria: Douglas-fir; dominant or codominant; 30 to 50 feet (9.1 to 15.2 meters) in height; relatively open-grown with a full crown; some feeding evident, but not severely defoliated or with top-kill. Two 27.5-inch (70 cm) midcrown branches were cut from opposite sides of each sample tree with a pole pruner. Each branch was then individually bagged in $\frac{1}{4}$-bushel (.03 cubic feet) paper sacks, sealed, labeled, and transported to the laboratory for examination. All sacks were stored in a walk-in cooler at about 40° F (4.4° C) prior to examination.

In the laboratory, the length and width of each branch was measured to obtain an estimate of the foliated branch surface area. Then, the foliage was examined under ultraviolet light (Acciavatti and Jennings 1976) for egg masses. Finally, new egg masses (deposited in 1977) were separated from old ones (deposited before 1977) by a professional entomologist. The number of old egg masses in a given year reliably estimates the number of new egg masses the previous year (Buffam and Carolin 1966).

Mean densities of 1976 and 1977 egg masses per 1,000 square inches (.6 square meters) of foliage were calculated for each unit to determine infestation trend and predict defoliation expected in 1978. Infestation trend was based on testing the mean density difference between 1976 and 1977 egg masses with a "t" value ($P < .05$). Both increasing and decreasing infestation trends would have significant density differences from year to year, but an increasing trend would have a ratio of new (1977) to old (1976) egg masses greater than 1, while a decreasing trend would have a ratio of less than 1. A non-significant density difference would indicate a static infestation trend. Defoliation predictions were obtained from the density of 1977 egg masses using Table 1.

RESULTS AND DISCUSSION

Western spruce budworm survey data from each entomological unit are presented in Table 2. Budworm infestations have enlarged in Region 3 since last year. Defoliation was visible on 197,788 acres in 1977 compared to 123,760 acres in 1976. Egg mass survey data indicate increasing infestation trends in all units except the Sandia, which has a decreasing trend. Units with an increasing trend should have at least moderate defoliation in 1978. The Sandia unit should have at least light defoliation next year.

Budworm populations have remained at high levels in the Southwestern Region for the third consecutive year. Tree damage from defoliation is just beginning. Growth loss has occurred in some isolated stands, but top-kill and tree mortality has been minimal. Moderate to heavy defoliation for 3 to 5 consecutive years will result in permanent tree damage. The present infestations are not expected to cause such damage next year, except in limited areas.

RECOMMENDATION

Since the infestations have caused only minimal tree damage thus far, suppression is not recommended for 1978.

LITERATURE CITED

Acciavatti, R. E., and D. T. Jennings. 1976. Locating western spruce budworm egg masses with ultraviolet light. USDA Forest Serv. Res. Note RM-313. 3 pp.

Buffam, P. E., and V. M. Carolin, Jr. 1966. Determining trends in western spruce budworm egg populations. J. Econ. Entomol. 59(3): 1442-44.

McKnight, M. E., J. F. Chansler, D. B. Cahill, and H. W. Flake, Jr. 1970. Sequential plan for western budworm egg mass surveys in the central and southern Rocky Mountains. USDA Forest Serv. Res. Note RM-174. 8 pp.

Table 1.--Class limits for western spruce budworm egg mass densities and defoliation classes (From: McKnight et al. 1970).

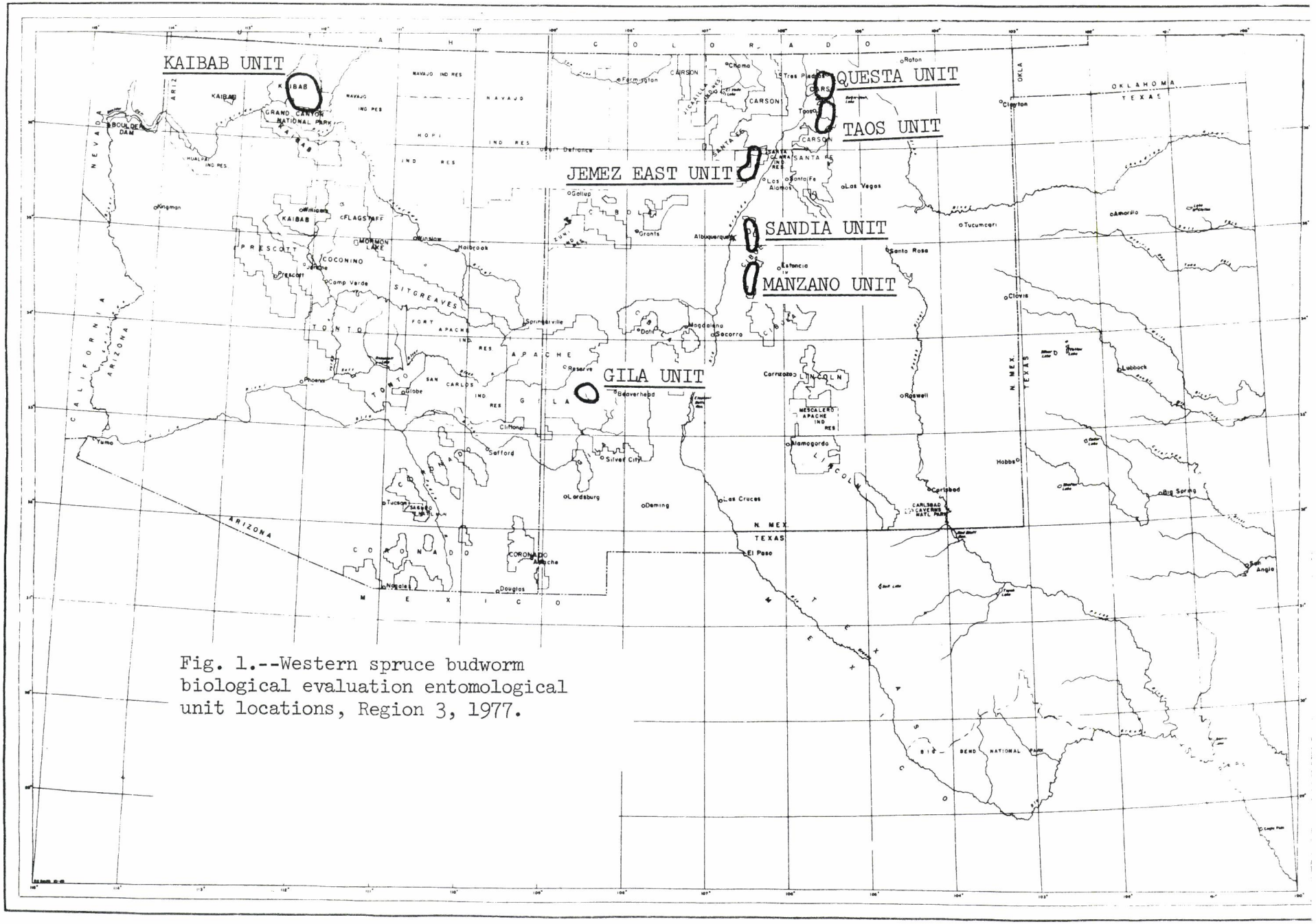
Egg mass density[1]	Predicted defoliation class[2]
<1.0	Undetectable for all infestations
1.1 to 4.0	Undetectable for "static" infestations Light for "increasing" infestations
6.0 to 20.0	Light for "static" infestations Moderate for "increasing" infestations
>22.0	Moderate for "static" infestations Heavy for "increasing" infestations

1/ New egg masses per 1,000 square inches of foliage.
2/ Defoliation class limits (percent of new growth)
Undetectable = <5%
Light = 5 to 35%
Moderate = 35 to 65%
Heavy = >65%

Table 2.--Summary of western spruce budworm infestations, Region 3, 1977

Entomological unit	Estimated acres of host type	Defoliated acres[1/]	No. of plots sampled	Egg mass densities[2/]			Infestation trend	Predicted 1978 defoliation class
				1976	1977	Ratio 1977:1976		
Gila	40,000	L = 4,160 M = 2,320 H = 0	10	3.1 ± 0.8	6.7 ± 1.8	2.2:1	Increasing	Moderate
Jemez East	100,000	L = 56,872 M = 1,556 H = 0	97	2.0 ± 0.3	8.1 ± 0.8	4.1:1	Increasing	Moderate
Kaibab	125,000	L = 64,400 M = 5,920 H = 400	20	5.6 ± 1.2	18.3 ± 4.6	3.3:1	Increasing	Moderate
Manzano	20,000	L = 8,440 M = 1,240 H = 800	19	5.7 ± 1.7	9.4 ± 1.3	1.6:1	Increasing	Moderate
Questa	50,000	L = 13,080 M = 960 H = 320	20	1.9 ± 0.6	6.6 ± 1.3	3.5:1	Increasing	Moderate
Sandia	12,000	L = 10,000 M = 920 H = 560	20	5.6 ± 1.6	3.1 ± 0.6	0.6:1	Decreasing	Light
Taos	75,000	L = 15,040 M = 10,800 H = 0	20	5.2 ± 1.5	14.3 ± 2.4	2.7:1	Increasing	Moderate
Totals	397,000	197,788	206					

1/ Aerial survey estimates: L = Light; M = Moderate; H = Heavy.
2/ Mean per 1,000 square inches of foliage.
3/ Mean ± standard error.


KAIBAB UNIT
QUESTA UNIT
TAOS UNIT
JEMEZ EAST UNIT
SANDIA UNIT
MANZANO UNIT
GILA UNIT
COLORADO
NEVADA
CALIFORNIA
ARIZONA
NEW MEX.
TEXAS
OKLAHOMA
MEXICO
NAVAJO IND RES
HOPI IND RES
APACHE
GILA
CARSON
SANTA FE
Flagstaff
Prescott
Phoenix
Tucson
Albuquerque
Las Cruces
El Paso
Roswell
Lubbock
Amarillo
Clayton
Raton
Taos
Santa Fe
Las Vegas
Gallup
Grants
Socorro
Silver City
Alamogordo
Carlsbad
Hobbs
Big Spring
Deming
Lordsburg
Safford
Globe
Yuma
Nogales
Douglas
Clifton
Springerville
Holbrook
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Estancia
Belen
Los Alamos
Farmington
Chama
Tres Piedras
Cerrillos
Dulce
Window Rock
Fort Defiance
Ganado
Chinle
Kayenta
Tuba City
Page
Cameron
Bullhead City
Kingman
Parker
Blythe
Needles
Barstow
Victorville
Palm Springs
Indio
Yuma
Gila Bend
Ajo
Sells
Casa Grande
Coolidge
Florence
Mesa
Tempe
Scottsdale
Wickenburg
Prescott
Jerome
Sedona
Flagstaff
Williams
Grand Canyon
Boulder Dam
Lake Mead
Lake Powell
Navajo Lake
Heron Lake
Abiquiu Lake
Elephant Butte Lake
Caballo Lake
Brantley Lake
Sumner Lake
Conchas Lake
Ute Lake
Meredith Lake
Amistad Reservoir
Falcon Reservoir
Big Bend National Park
Carlsbad Caverns Natl Park
Grand Canyon National Park
Petrified Forest Natl Park
Organ Pipe Cactus Natl Mon
Saguaro Natl Mon
Chiricahua Natl Mon
Coronado Natl Mem
Navajo Natl Mon
Aztec Ruins Natl Mon
Bandelier Natl Mon
Pecos Natl Hist Park
Salinas Natl Mon
Capulin Mountain Natl Mon
Fort Union Natl Mon
Petroglyph Natl Mon
Walnut Canyon Natl Mon
Wupatki Natl Mon
Sunset Crater Natl Mon
Tonto Natl Mon
Montezuma Castle Natl Mon
Tuzigoot Natl Mon
Casa Grande Ruins Natl Mon
Gila Cliff Dwellings Natl Mon
Chaco Canyon Natl Hist Park
Aztec Ruins Natl Mon
Mesa Verde Natl Park
Canyon de Chelly Natl Mon
Hubbell Trading Post Natl Hist Site
Hovenweep Natl Mon
Natural Bridges Natl Mon
Rainbow Bridge Natl Mon
Glen Canyon Natl Rec Area
Lake Mead Natl Rec Area
Lake Mohave
Lake Havasu
Colorado River
Rio Grande
Pecos River
Gila River
Salt River
Verde River
Little Colorado River
San Juan River
Canadian River
Red River
Brazos River
Colorado River
Concho River
Llano River
Nueces River
Frio River
Medina River
Guadalupe River
San Antonio River
Comal River
Blanco River
Pedernales River
Llano River
Concho River
Colorado River
Brazos River
Trinity River
Neches River
Sabine River
Red River
Canadian River
Arkansas River
Cimarron River
Beaver River
North Canadian River
Washita River
Red River
Ouachita River
Mississippi River
Missouri River
Platte River
Kansas River
Republican River
Smoky Hill River
Solomon River
Saline River
Big Blue River
Nemaha River
Little Blue River
Missouri River
Mississippi River
Ohio River
Tennessee River
Cumberland River
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Green River
Wabash River
White River
Illinois River
Kaskaskia River
Big Muddy River
Meramec River
Gasconade River
Osage

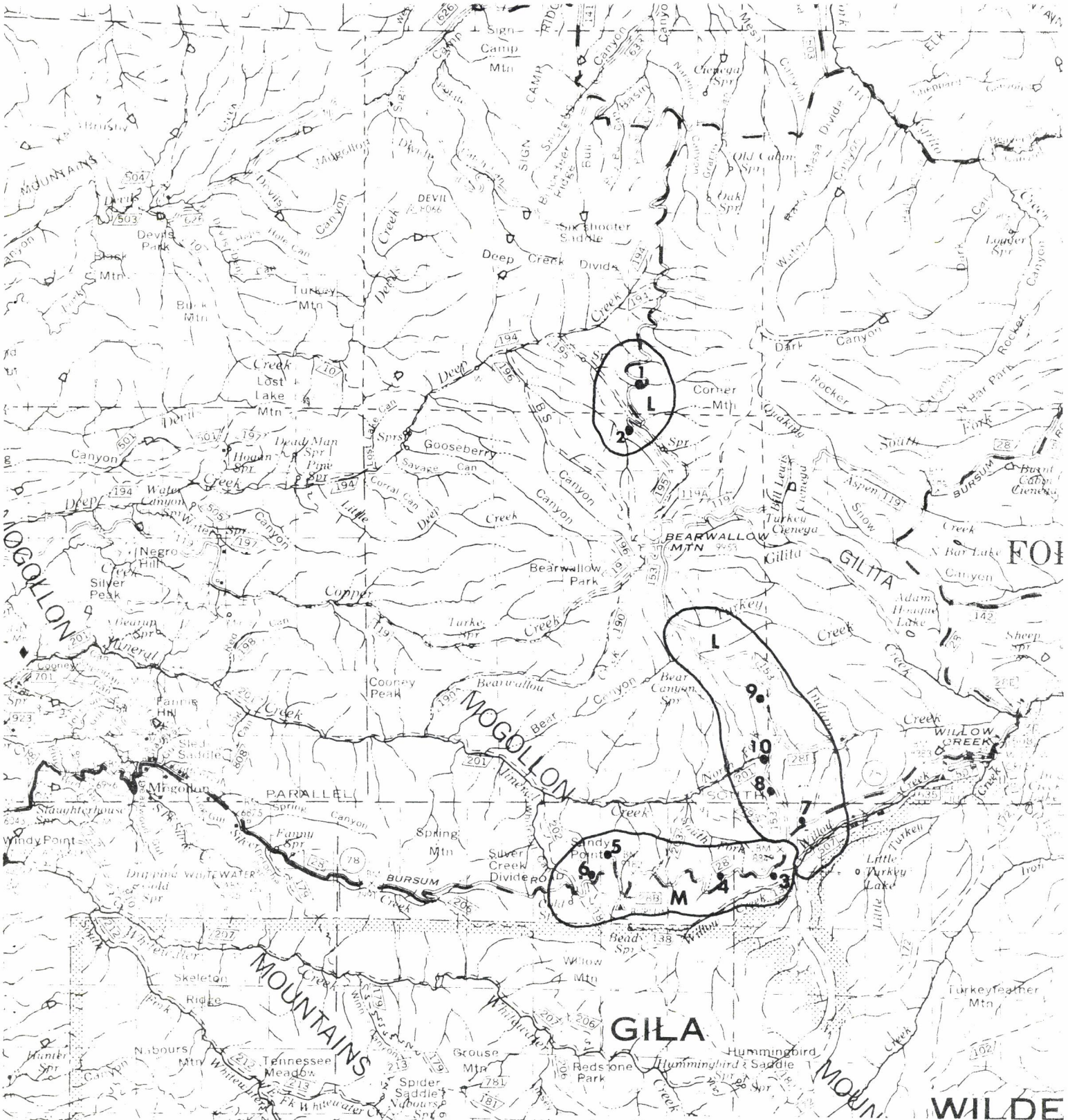

Fig. 2.--Western spruce budworm infestation, Gila Unit, Gila NF, 1977.

Legend

Evaluation Plot Locations	2
Defoliation Intensity	
Light	L
Moderate	M
Heavy	H

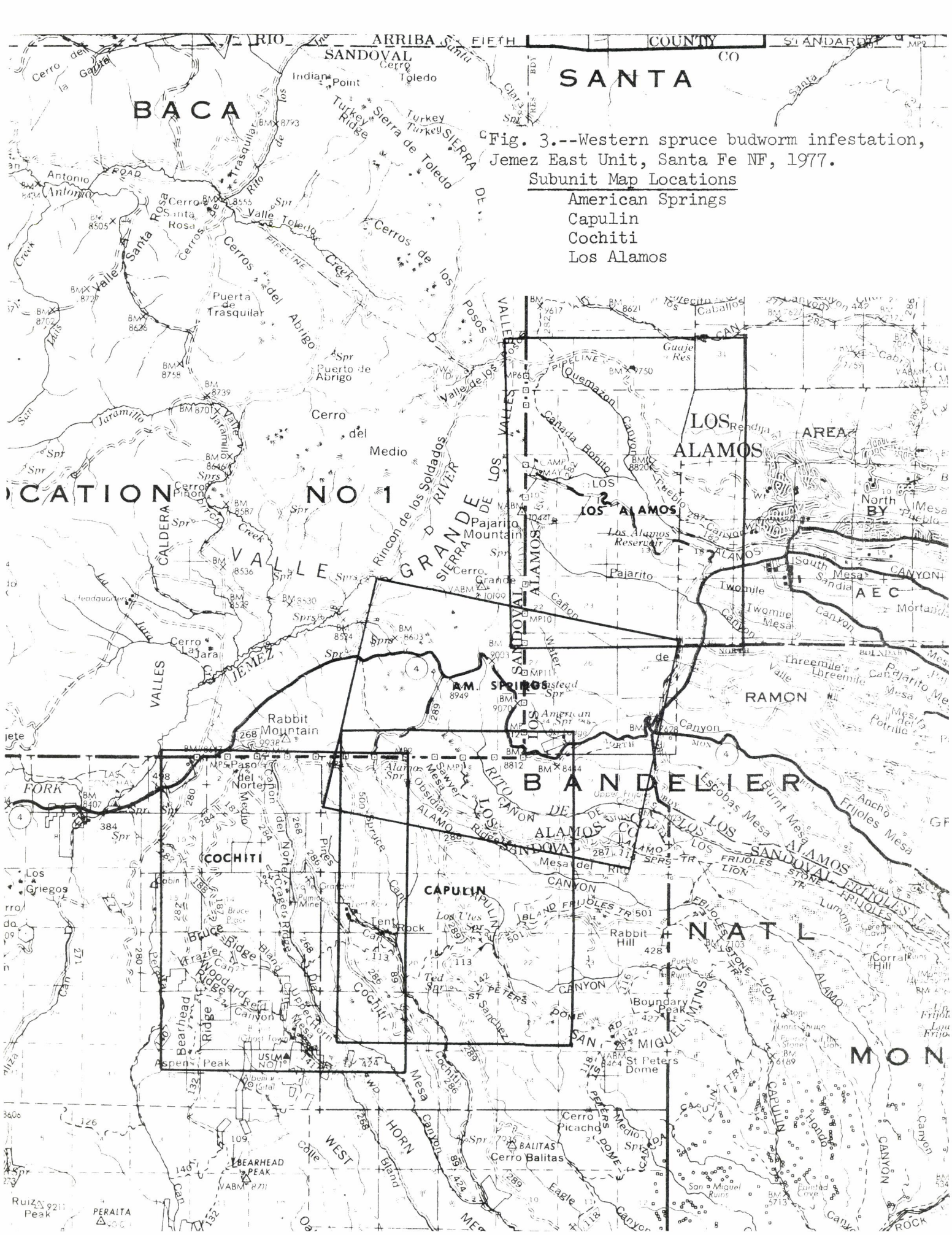

Fig. 3.--Western spruce budworm infestation, Jemez East Unit, Santa Fe NF, 1977.

Subunit Map Locations

American Springs
Capulin
Cochiti
Los Alamos